AMERICAN FOULBROOD of HONEY BEES

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--how to control it

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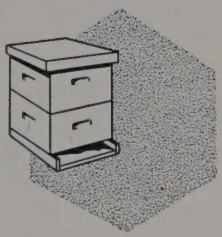
AMERICAN FOULBROOD OF HONEY BEES— How To Control It



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American foulbrood is a disease of the brood of bees which causes serious losses to beekeepers. It destroys large numbers of colonies and increases the cost of apiary operation. The presence of the disease in or near an apiary can cause such mental anxiety to some beekeepers that it can prevent them from succeeding in the bee industry.

American foulbrood is worldwide in its distribution and is widespread in the United States. All races of honey bees are susceptible. Worker larvae are particularly susceptible, but queen and drone larvae are also affected occasionally. Adult bees are immune to it.

CAUSE OF THE DISEASE

American foulbrood is caused by a germ known as *Bacillus larvae*. The living honey bee larva is the only known host of this germ. *Bacillus larvae* occurs in two forms, a vegetative form and a spore form. The disease is transmitted primarily by means of the spore form.

These spores may come in contact with larvae of any age, but they are able to germinate and start growing only in larvae not more than about 2 days old. The larvae rarely die until they have developed to the point where they are capped over and lie lengthwise in their cells. However, occasionally a larva dies while it is still in the coiled stage.

In attempting to remove the diseased brood, the bees that work within the hive become contaminated with these spores and, acting as carriers, spread them from cell to cell. In doing such tasks as feeding the larvae, building cells, ripening nectar, and transferring honey from one part of the hive to another, these bees can contaminate not only the honey that is in the brood nest, but also that in the supers.

After the disease has spread throughout the brood nest, dead brood increases faster than the bees can remove it, the colony gradually becomes weaker, and eventually dies because there are not enough emerging bees to carry on the colony.

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HOW THE DISEASE IS SPREAD

The spores of *Bacillus larvae*, which are invisible to the naked eye, are extremely resistant to sunlight, drying, heat and cold, the dehydrating action of honey, and to commonly used chemical disinfectants. These spores are known to remain alive for years in honey and brood combs, and are spread from colony to colony by bees from strong healthy colonies robbing contaminated honey from disease-weakened colonies. The beekeeper often aids in this process by manipulations that stimulate robbing. He may also unwittingly spread the disease within an apiary when he moves combs of brood and honey from one hive to another or unites colonies.

The transportation of infected material, including honey, into a disease-free area spreads the disease beyond the flight range of the bee. The sale of contaminated equipment is one of the principal avenues through which the disease is spread from one locality to another. Buyers of used beekeeping equipment, such as old hives and appliances and drawn comb, should make sure that it is free of disease. Some States restrict the sale of used equipment to that known to be not contaminated, and some prohibit the interstate shipment of bees on combs.

DIAGNOSIS

In the Apiary

The spores of *Bacillus larvae* can be recovered and identified by bacteriological technique only. However, the beekeeper can recognize the disease in the apiary by the discolored, sunken, and punctured cappings and the isolated sealed cells in the midst of recently emerged brood. The dead larvae are usually extended lengthwise in the cells (fig. 1). Dead larvae are slightly yellowish or dirty white at first, but become chocolate brown or black upon further decay. Shortly after death, and until the content of the cell becomes too thick, the larval material can be drawn out with a toothpick or match into a gluelike thread. The dead larva lies extended along the lower side wall with the rear portion curved part way up the bottom of the cell. The brood remains, called scales, become tough and brittle upon aging, and adhere so tightly to the floor and base of the cells that the bees either cannot or do not attempt to remove them. The scales are very thin and in old, dark combs are easily overlooked.

Pupae that die of the disease undergo similar changes in color and consistency and in the final formation of scale (fig. 2). Occasionally the tongue of a dead pupa adheres to the roof of the cell.

Bees remove many of the cappings from cells containing dead brood, making it appear that the larvae or pupae died before being sealed. American foulbrood has a characteristic unpleasant odor, which is pronounced when the disease is in an advanced stage.

The uniformity of the symptoms characterizes this disease more than does any one symptom. Whenever you suspect disease, examine isolated cells having discolored, sunken, or punctured cappings in the midst of healthy emerging brood. It is not difficult to make a reliable diagnosis in the apiary, except perhaps when only 1 or 2 dead larvae or pupae in the earliest stage of decomposition are present. In such cases send a portion of the comb containing the suspected brood to a

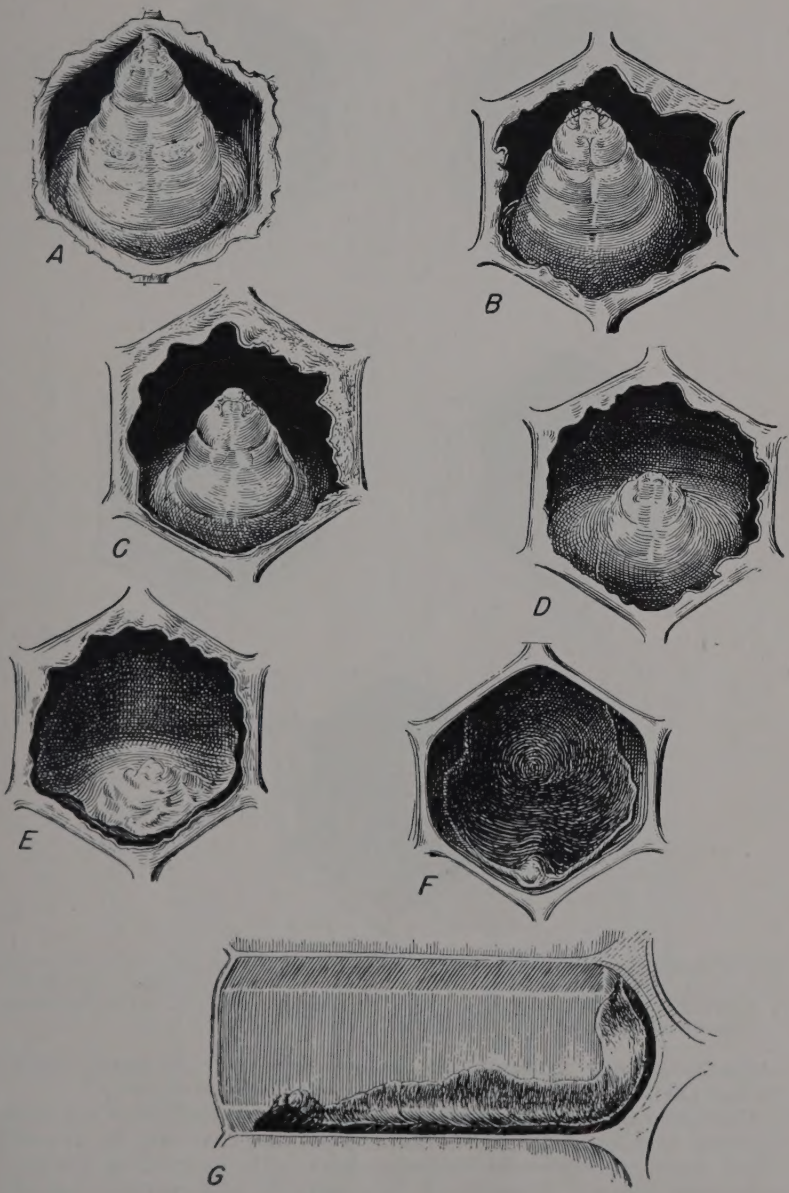

FIGURE 1.—Honey bee larvae killed by American foulbrood, as seen in the cells. *A*, Healthy larvae at the age when most of the brood dies of American foulbrood. *B*, *C*, *D*, *E*, *F*, Dead larvae in progressive stages of decomposition. The remains shown in *F* is called scale. *G*, Longitudinal view of a scale.

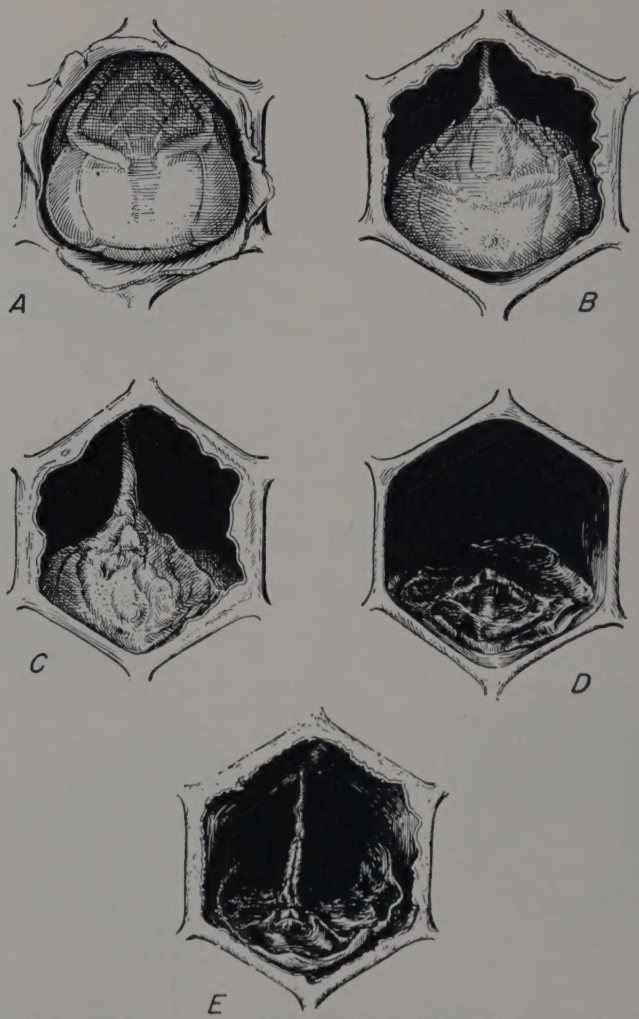

FIGURE 2.—Honey bee pupae killed by American foulbrood, as seen in the cells. *A*, *B*, *C*, Heads of pupae in progressive stages of melting down and decay. *D* and *E*, Scales formed from drying of dead pupae. In *B*, *C*, and *E* the tongue is shown adhering to the roof of the cell.

competent apiary inspector. In the meantime leave the colony undisturbed until the nature of the trouble has been determined.

Colonies have been treated in the erroneous belief that they were infected with American foulbrood, and colonies have not been treated when American foulbrood has been mistaken for some of the less serious brood diseases. Therefore it is important that a correct diagnosis be made before treatment is applied. For this reason two other common brood diseases, European foulbrood and sacbrood, are described briefly, and the symptoms of all three diseases are compared in the accompanying table.

Comparative symptoms of brood diseases of honey bees

Symptom	American foulbrood	European foulbrood	Sacbrood
Appearance of brood comb.	Sealed brood. Discolored, sunken or punctured cappings.	Unsealed brood. Some sealed brood in advanced cases with discolored, sunken, or punctured cappings.	Sealed brood. Scattered cells with punctured cappings, often with two holes.
Age of dead brood.	Usually older sealed larvae or young pupae. Occasionally younger unsealed larvae.	Usually young unsealed larvae. Occasionally older sealed larvae.	Usually older sealed larvae. Occasionally young unsealed larvae or young pupae.
Color of dead brood.	Dull white, becoming yellow, light brown, coffee brown, to dark brown or almost black.	Dull white, becoming yellowish white to brown, dark brown or almost black.	Grayish or straw-colored becoming brown, grayish black, or black. Head end darker.
Consistency of dead brood.	Soft, non-sticky, becoming sticky to ropy.	Watery to pasty. Rarely sticky or ropy.	Watery and granular. Tough skin forms a sac.
Odor of dead brood.	Slight to pronounced glue or glue-pot odor.	Slight to penetratingly sour.	None to slightly sour.
Scale characteristics.	Brittle. Rough texture. Lies flat on lower side of cell. Adheres tightly to cell wall. Head lying flat. Fine, threadlike tongue of dead pupae adheres to roof of cell.	Tough and rubbery. Smooth texture. Usually twisted in cell. Does not adhere tightly to cell wall.	Brittle. Rough texture. Lies flat on lower side of cell. Does not adhere tightly to cell wall. Head prominently curled up.

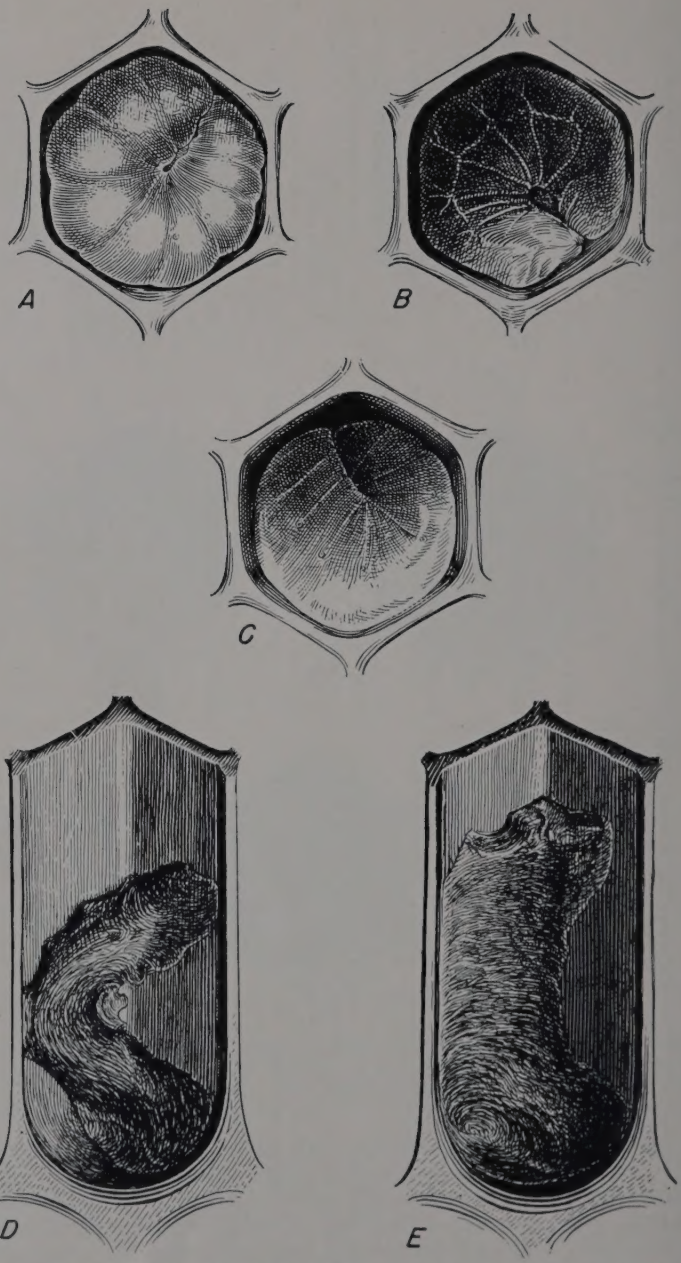

FIGURE 3.—Honey bee larvae killed by European foulbrood, as seen in the cells. *A*, Healthy larva at earliest age when the brood dies of European foulbrood. *B*, Scale formed by a dried-down larva. *C*, One of several positions of sick larvae prior to death. *D* and *E*, Longitudinal views of scales from larvae that had assumed a lengthwise position prior to death.

European foulbrood usually kills the larvae in the coiled stages (fig. 3). The dead larvae are yellowish white. The brood remains are watery, pastelike, or granular, the appearance varying according to the age at which the larvae die. The scales do not adhere tightly to the cells and are usually removed by the bees in a strong colony. Occasionally larvae dead of European foulbrood become brown and ropy and present other symptoms similar to those of American foulbrood (fig. 4). In such cases a correct diagnosis usually can be made only after examination under a microscope.

Sacbrood kills the larvae while they are extended in the cell (fig. 5), and the cappings become sunken and perforated, as in American foulbrood. The dead larvae are grayish at first, but become brown or black as decay advances. The heads remain erect and darken faster than the rest of the body during the process of decay. The larval skin becomes tough and saclike, thus giving the disease its name, and the material inside is watery and granular. The brood remains do not adhere to the cells; therefore, the bees are able to remove them and the disease does little damage.

In the Laboratory

Diagnosis of the disease in the laboratory is a service that is made available to beekeepers and State apiary inspectors by the Department of Agriculture.

A sample for laboratory examination should consist of a piece of brood comb at least 4 or 5 inches square which contains as much of the dead, discolored brood as possible. *No honey should be present*, and the comb should not be crushed.

Mail the sample in a wooden or strong cardboard box. Do not use a tin, glass, or plastic container, and do not wrap the comb in waxed paper or aluminum foil. Address all samples to the Beekeeping and Insect Pathology Section, Entomology Research Branch, Agricultural Research Center, Beltsville, Md. Your name and address should be plainly written on the box. If the sample is forwarded by an inspector, his name and address should also appear on the box.

HOW TO CONTROL THE DISEASE

Destroy Diseased Colonies

As soon as you discover American foulbrood in your apiary, destroy all diseased colonies immediately by burning. Treat the remaining colonies with one of the sulfa drugs as a preventive measure (see page 11). Before you burn the diseased colonies, however, the bees must be killed. A tablespoonful of calcium cyanide spread on a sheet of paper or cardboard and slipped into the entrance of the hive will kill the bees in a few minutes. But first be sure all flight activity has stopped.

Calcium cyanide is poisonous. Handle it with great care. Occasionally the bees fall onto the poison so rapidly as to prevent the fumes from penetrating to all parts of the hive. Therefore, as an extra precaution, place additional cyanide on a piece of paper above the top bars and under the inverted inner cover and replace the hive cover.

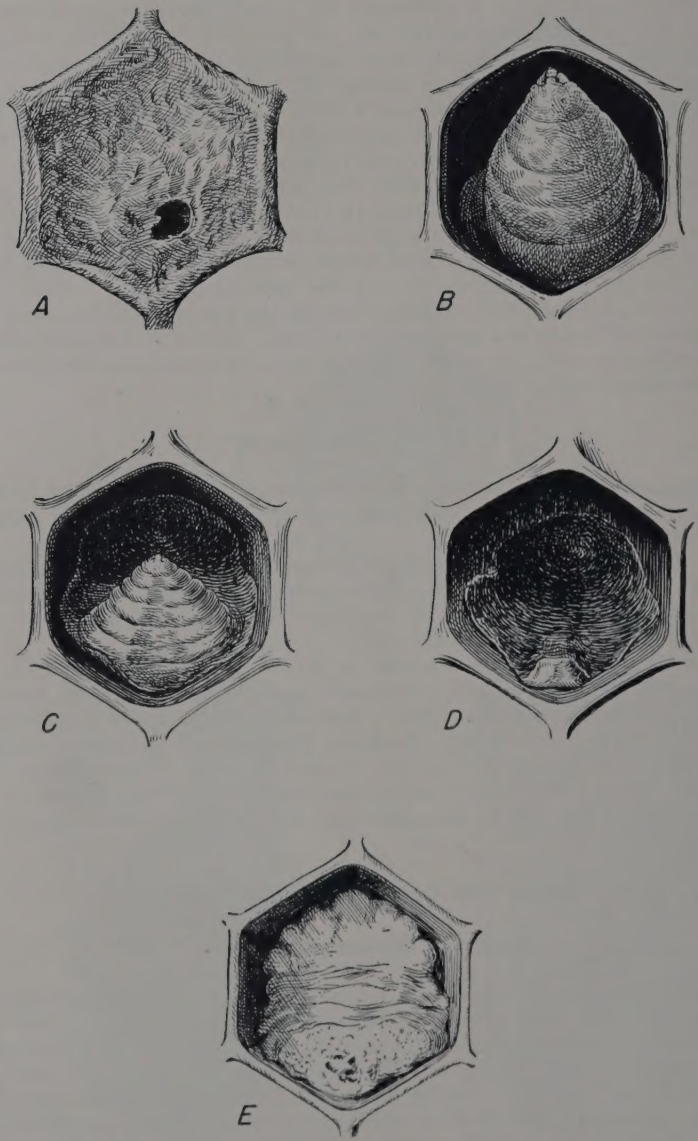

FIGURE 4.—Honey bee larvae killed by European foulbrood, showing symptoms similar to those killed by American foulbrood. *A*, Sunken and perforated capping of a cell containing a dead larva. *B*, and *C*, Larvae in different stages of decomposition lying lengthwise in the cells. *D*, Scale formed by dried-down larva. *E*, Remains of a larva, part of which has been removed by the bees.

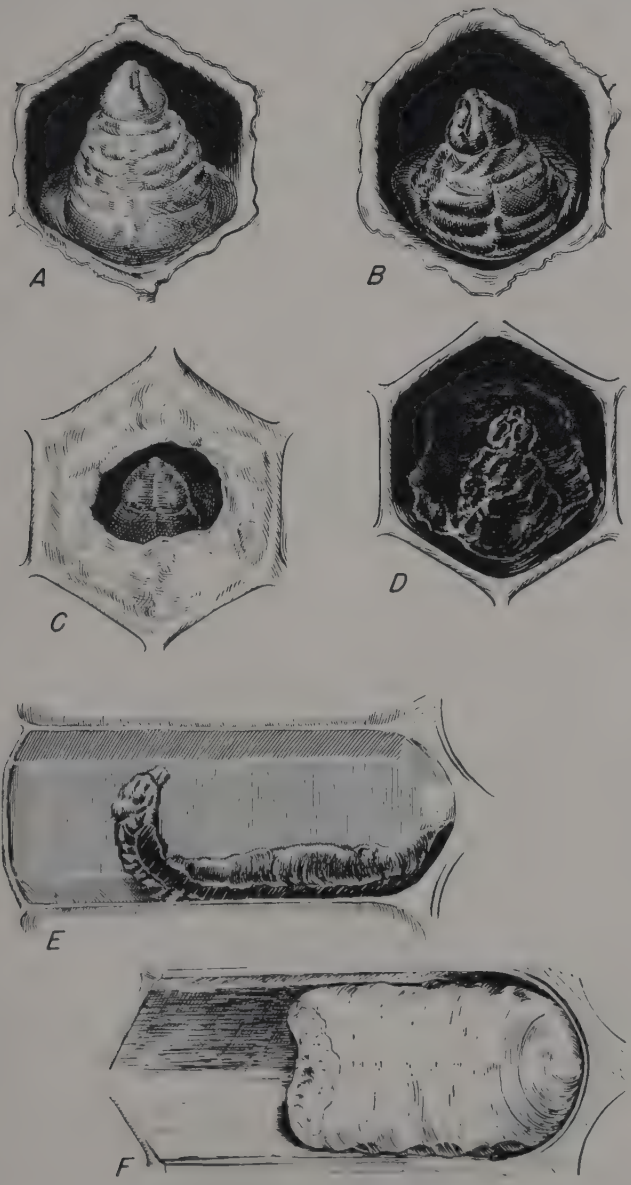

FIGURE 5.—Honey bee larvae killed by sacbrood as seen in the cells. *A* and *B*, Larvae in different stages of decomposition. *C*, Erect head of a dead larva showing through an opening made by the bees in the capping. *D* and *E*, Two views of the scale. Note how the head remains erect. *F*, Remains of a larva, the head of which has been gnawed away by the bees.

Leave the entrance of the hive open so that any field bees that may try to gain entrance will also be killed.

You can also use gasoline to kill bees. Close the entrance to the hive, pour a pint or more of gasoline over the frames, and then close the hive tightly.

After the bees have been killed, burn the contents of the hive with the least possible delay to avoid trouble from robber bees, as both calcium cyanide and gasoline act as repellents for only a short time.

Before you kill the bees, dig a pit 18 inches or more deep and wide enough to hold all the material to be burned, in a place not likely to be plowed or otherwise disturbed. Then kindle a hot fire with plenty of scrap material and with cross members, strong enough to support the weight of the frames, placed so as to permit plenty of ventilation underneath. A brisk, hot fire is necessary to burn the brood and honey completely.

Carry the hives containing the dead bees close to the pit, and feed the bees and frames to the fire as fast as possible. Do not burn the bottom board, hive bodies, inner covers, or hive covers. If you place the hives on pieces of burlap or strong paper, it will be easy to gather up and burn the bits of comb, honey, or dead bees that may be dropped during the operation. After everything has been completely burned, rake the topsoil surrounding the fire into the pit to prevent bees from healthy colonies from having access to any dead bees or honey, and then fill the pit.

If you kill the bees and do the burning at night, the danger of interference from robber bees will be lessened. It is important, of course, to have everything well planned and all material at hand.

Take Care of Contaminated Equipment

After the burning, scrape the hive bodies, bottom boards, inner covers, and hive covers thoroughly to remove all propolis and wax, and then scrub them inside and out, with a stiff brush and hot soap or lye solution. Burn the scrapings and dispose of the wash water in such a manner that it is not accessible to the bees.

Washing with soap and water is also the best way to remove spores from the hands, clothing, tools, and extracting equipment.

If it is not possible to wash the hive bodies, stack them to form a chimney seven to eight bodies high with the top edges down. Sprinkle the inside walls with kerosene, then ignite the kerosene. A little ventilation and fuel at the bottom of the stack will produce a hot fire. As soon as the inside is scorched, smother the fire by placing a board over the top super. A gasoline blowtorch is a handy tool for scorching, but its use is rather slow. Disinfecting solutions are no longer recommended in the treatment of American foulbrood.

Preventive Treatment With Sulfa Drugs

The burning of diseased colonies in the apiary gets rid of only those colonies in which American foulbrood is plainly present in an active form. If there has been any shifting of the brood combs, if super combs have been transferred from one colony to another, or if diseased colonies have been robbed out, disease will probably show up later in other colonies.

To prevent or reduce to a minimum this general spreading of the disease throughout the apiary, treat the remaining colonies with one of the sulfa drugs.

Although a number of sulfa drugs have been used to treat American foulbrood, sulfathiazole is the drug of choice. It is available in convenient ½-gram tablets. Use ½ to 1 gram in 1 gallon of sugar syrup containing 2 parts of sugar to 1 part of water. Less than ½ gram of sulfathiazole is too weak a dose and more than 1 gram has sometimes been toxic to the brood. Since sulfathiazole is only slightly soluble in water, pulverize the tablets and then dissolve them in a cup of hot water (not over 180° F.) before mixing them with the sirup. A soluble powder form of the drug, sodium sulfathiazole, is easier to use. A scant ¼ teaspoonful of this drug is approximately equal to ½ gram.

Feed the medicated sugar sirup in the usual manner in a perforated honey pail inverted over the brood combs or by means of an entrance feeder. From 1 to 2 gallons of the treated sirup should be sufficient to protect a colony from infection.

If you prefer to feed honey rather than sugar sirup, dilute the honey with an equal volume of water before adding the sulfathiazole. This is necessary to obtain an even distribution of the drug in the honey solution. Honey purchased on the open market should not be fed to your colonies if it can be avoided. However, if it is found necessary to use this type of honey, always add sulfathiazole to it before feeding.

Sulfathiazole can also be incorporated in pollen-supplement cakes for feeding in the early spring. Add 1 gram of sodium sulfathiazole to each gallon of sugar sirup used in mixing these cakes and feed as much as the colonies can use in brood rearing. The pollen supplement itself will increase brood rearing and thereby the strength of the colonies.

A rapid method of making the drug directly available to the bees is to spray the colony with a sulfathiazole sirup. To make this sirup use 2 parts of water to 1 part of sugar and add 1 gram of the drug to each gallon. Spray between the combs from below and above, starting with the bottom hive body and working upward as you reassemble the hive. Apply the spray twice each week for at least 3 weeks, using from 1 to 4 pints for each spraying, depending upon the strength of the colony. Wet as many adult bees as possible.

Sulfathiazole sirup reduces the development and spread of American foulbrood, but it does not destroy the spores of *Bacillus larvae*. When spores are ingested by young larvae of susceptible ages along with food containing sulfathiazole, the germination of the spores is delayed, or if the spores are able to germinate, growth of the germ is stopped.

Therefore, though the drug may control the germ so that there is no visible evidence of the disease, virulent spores may still be present in the colonies. The spores may be hidden in honey or pollen that may not be consumed for a long time, or may adhere to the sides of cells or on hive bodies, and be invisible and harmless as long as they remain in those places.

When such hidden spores, carried by worker bees, are ingested by larvae less than 2 days old in a colony that has not been treated for some time, the infection may recur. Therefore, it is necessary to keep

treated colonies under close observation for 3 to 4 years or perhaps longer. During this period it is unwise to shift hive equipment, including super combs, between apiaries containing treated colonies and apiaries having no previous record of disease. If a treated colony becomes diseased, burn it immediately and treat the remaining colonies with sulfathiazole again.

BEES RESISTANT TO AMERICAN FOULBROOD

Progress has been made in breeding strains of bees resistant to American foulbrood, but breeders cannot yet guarantee resistant queens unreservedly. Best results with resistant stock have been obtained in prevention rather than eradication of the disease. By using strains of bees that show superior resistance you can reduce losses from American foulbrood. To obtain the best results, requeen the entire apiary. In case of supersedure, or if the queens have to be replaced, use resistant stock. Otherwise the resistant character will be lost.

Do not requeen diseased colonies in an attempt to control the disease. Burn them. Also burn any colony that develops the disease even though it is of supposed resistant stock.

More selective breeding work is neceessary before completely desirable resistant strains of bees can be developed. However, resistance to American foulbrood does exist in honey bees. This characteristic can be inherited; therefore the eventual development of a strain highly resistant to this disease is possible.

TREATMENT BY STATE INSPECTORS

Under most conditions inspectors are justified, and in some States required, to burn every diseased colony immediately, because such a colony is a menace to all healthy colonies in the vicinity. The maintenance of such a serious nuisance as a colony containing American foulbrood should not be tolerated. The best interests of the industry demand the prompt disposal of all such colonies.

When a State inspection force is applying the area-cleanup method for the first time, however, and when the incidence of the disease is high, treatment rather than burning may be justifiable. The advisability of treatment depends not only upon the amount of disease in a particular apiary or area, but upon the character of the beekeeping, the kind of equipment employed, the facilities and experience of the beekeepers for doing the job, and the statutes governing the control of bee diseases.

However, do not wait for an inspector to discover and burn your infected colonies. Inspect all your colonies periodically and promptly destroy every diseased one.

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- Cause loss of 17 million man-days of farm labor, or the services of 46,000 men working every day for a year.

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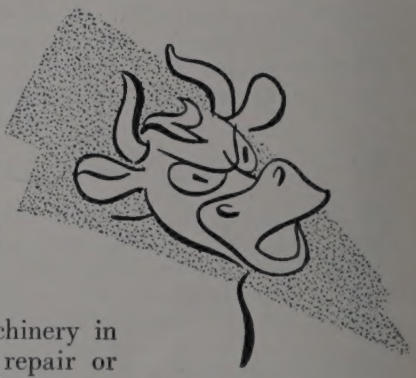

- Keep tractors and other farm machinery in good repair. Equipment in bad repair or carelessly handled ranks first in killing or injuring farm people.
- Handle bulls and other farm animals carefully. They rank second in causing farm accidents and deaths.
- Use sharp-edged tools with caution—sickles, saws, corn knives, chisels, screwdrivers, axes.
- Take proper care in using, handling, and storing insecticides and other poisonous chemicals.
- Install, use, and repair electrical appliances and equipment properly.

You can lessen the seriousness of many accidents by immediate and proper care. Keep a first aid kit handy and know how to use it.
Call a doctor.